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Date: September 12, 2003

To: Dr. Stuart Styles, ITRC Director

From: Randy Ishii, Student Assistant Engineer

Subject: Underground Pipe Locating Demonstration at Arvin-Edison Water Storage District
Site Visit Report: August 13, 2003

A site visit was conducted at the Arvin-Edison Water Storage District (AEWSD) on August 13, 2003. The purpose of the site visit was to oversee the underground pipe locating demonstration/presentation arranged by the Irrigation Training and Research Center (ITRC) and funded by the USBR Mid-Pacific Region. The presentation was coordinated with the help of Greg Kunzmann and Chris Krauter from the AEWSD. In all, approximately 22 people attended the demonstration. This report includes photographs of the demonstration.

Contact Information

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Itinerary

Aug. 13, 2003 Met with Steve Gamblin, Stan Dubois, and the district representatives at the AEWSD conference room. Helped vendors set up their equipment for display and presentation. Assisted with and took careful notes of the proceedings.

Summary

General

A presentation/demonstration of some of the latest underground pipe locating equipment was conducted on August 13, 2003 at the Arvin-Edison Water Storage District. All the techniques shown were non-destructive pipe locating procedures that provide approximations to the depth and location of underground-buried pipe.

3 types of technology were shown at the demonstration:

1. Acoustic pipe locators
2. Leak detectors
3. Ground penetrating radar

Each form of technology has its own merits and advantages. Acoustic technology is effective in locating single, small diameter pipes with pressurized flow located within about 500-ft of the sound (sonde) units. Leak detection technology is more accurate in locating leaks and pipelines than acoustic technology. Leak detectors can also locate pipes at deeper depths than can acoustic detectors, but require water flowing through the pipe during instrument operation and are also more costly. Ground penetrating radar is highly accurate in locating and approximating the depths of buried objects; this radar technology is also faster and requires less skill to operate and interpret readings than the other types of pipe location. However, the effectiveness is dependent on soil types, depth of pipes, and soil salinity. It is crucial to remember, though, that underground pipe locating technology is only a tool for finding approximate locations and depths of buried pipes, not exact positions. For optimum pipe location, the site conditions must first be evaluated to determine the proper underground pipe locating instrument.

Acoustic Pipe Locators

Acoustic pipe location depends on the vibrations produced in the pipeline, regardless of the pipe material or the application. Acoustic location requires a sound-producing attachment called the transmitter, which has to be hooked to the pipe by its valves, exposed ends, etc.

Accuracy and effectiveness are affected by many factors in acoustic pipe locating technology. Problems with acoustic technology include:

1. Bleed-over – occurred most frequently with metal pipe. This problem can be overcome with additional locators and/or detector orientation with the ground.

2. Distance – as the distance from the sound unit increases, the intensity of the signal decreases.

3. Pipe material – plastic (PVC or PE) pipes conduct a weaker signal than concrete or steel pipes.

4. Soil types – clay textured soils inhibit the clarity of the produced signal from the buried pipe.

Acoustic pipe locators are the least expensive units in terms of initial capital cost. They require some operator skill, but are less sensitive to outside noise interference. Under ideal conditions of low moisture sandy soils with low levels of salinity, a 6-in. diameter PVC pipe can be located at depths ranging from 2-ft to 3-ft. Therefore, these locators are best suited for low moisture, low saline soils with small (less than 1-ft diameter) pipes when economics is a primary concern.

These units are available from both Radiodetection and Metrotech. California Utility Equipment, the Metrotech dealership, has models priced at about $1,400 as of August 2003 (See the Metrotech 800 Series and RSP3 Plastic Pipe Locator attachments and the Radiodetection RD500 attachment).

Leak Detectors

Leak detectors incorporate technology similar to the acoustic pipe locators. Leak detectors specialize at locating pipeline leaks, but they can also locate just the pipes themselves. The sensor units transmit a signal into the ground and vibrate throughout the pipe. The headphone units detect the sound and vibrations coming from the pipe, and the greatest intensity shows the location of the buried pipeline.

Leak detectors are much more sensitive, and therefore, are able to locate pipes at much greater depths than acoustic detectors. For instance, under equal conditions of soil, weather, etc., an acoustic locator can reach depths around 2-ft to 3-ft, while a leak detector can reach depths of up to 6-ft. The disadvantages of these units are that they require a greater degree of operator skill, are about twice as expensive, and are much more sensitive to outside noise interference, such as vehicular traffic and construction sites, than acoustic models. Under the same ideal conditions for acoustic pipe locators, a 6-in. diameter PVC pipe can be located as deep as 6-ft. Therefore, these units are best suited for applications when accuracy is a great concern, pipes are of large diameters (over 1-ft), buried depths are estimated to be up to 5-ft to 6-ft, and the users have the extra money to spend.

These units are available from both Radiodetection and Metrotech. California Utility Equipment, the Metrotech dealership, has models available from $1,550 to about $3,800, depending on the type of unit (August 2003). (See SubSurface Leak Detection Model LD-12.)

Ground Penetrating Radar

Ground penetrating radar (GPR) represents the latest in underground pipe locating technology. Once used exclusively by the military, ground penetrating radar has now reached the civilian market. At AEWSD, the Easy Locator unit made by Mala GeoScience (see attachment) was displayed. The unit, which resembled a lawnmower with LCD screen on the top of the handles, requires the operator to push the unit along the ground until a disturbance in the screen is observed.

Ground penetrating radar units are found to be very effective, accurate, and quick and easy to implement. However, the effectiveness is dependent on a number of factors such as:

1. soil moisture - moist soils inhibit radar signals, while dry soils allow radar waves to easily reflect off of the buried object and be translated onto the LCD screen.

2. soil texture - radar signals penetrate the ground much more intensely in sandy soils and rock than in clay textured soils.

3. soil salinity/minerals – saline soils and minerals, especially iron, inhibit radar waves and create poor images on the GPR screen.

These units are easily set-up in the field and are simple to operate (low operator skill), thus saving time and money on labor. In dry, sandy soils with low levels of salinity/minerals, a GPR can locate pipes at depths up to 3-ft to 6-ft. The deepest depth recorded with a GPR unit of the displayed model was about 18-ft. However, the capital cost of these units is the most inhibiting concern. The cost of these units from Instrument Technology Corporation is slightly under $10,000. Therefore, these units are best suited for applications where quick, accurate pipe surveys are required and capital cost is not a concern.

The ground penetrating radar unit is available through Stan Dubois of Instrument Technology Corporation.

Photographs

Site photographs of acoustic pipe locators (**Fig. 1**), leak detectors (**Fig. 2**), and ground penetrating radar (**Fig. 3**) are attached and titled below.

Fig. 1. Acoustic Pipe Locator by Metrotech

Fig. 2. Leak Detector by Radiodetection

Fig. 3. Ground Penetrating Radar Unit by Mala GeoScience

Practical District Experience

One of the attendees is currently involved with these new technologies. He has met with various vendors, purchased equipment, and offered the following information:

> The attendee's water district is currently using the Metrotech Model 9800XT Pipe and Cable Locator. The district also purchased a 4" cable clamp, which is useful for locating underground conduits and direct-burial cable. The district's purchasing decision was primarily influenced by the Metrotech unit's ease of usage. For example, with the Metrotech, the unit operator does not have to switch continually back and forth from the peak mode to the null coil mode as is required by similar products on the market. The Metrotech is always in the null mode, so the operator gets a left/right audible signal and no signal when the operator is directly on top of what he or she is trying to locate. This saves a lot of time because the operator is not continually double-checking the unit for accuracy. Another reason for this purchasing choice is the versatility of the entire unit. Not only can the unit be used to locate power and metal valve box lids, but it can also be used to check for local radio wave interference all by clicking a knob on the unit's receiver. This simplicity of design eliminates the need for carrying or purchasing a lot of extra equipment.
>
> The attendee's water district also has some leak detection equipment, specifically the Subsurface Leak Detection LD-12 from Radiodetection. The unit has good acoustics, and it is very easy to use. The unit's operator does not have to look at and understand the bar graphs on the unit. The unit merely requires that the frequency filters be set, and then the unit is ready for use. This unit comes with a magnet that can be placed directly on pipes and valve nuts. It also has a probe that can be pressed into the ground, closer to the leak for better verification of the exact location of small leaks. Leaks have been located up to 45 feet away from the surfacing point of the water. This unit has already paid for itself in the way of alley and street repairs. Without the unit, the district would still be tracking water leaks from the surface point to the actual leak; this is very

costly in both labor and material repairs such as concrete sidewalk and black top street repairs.

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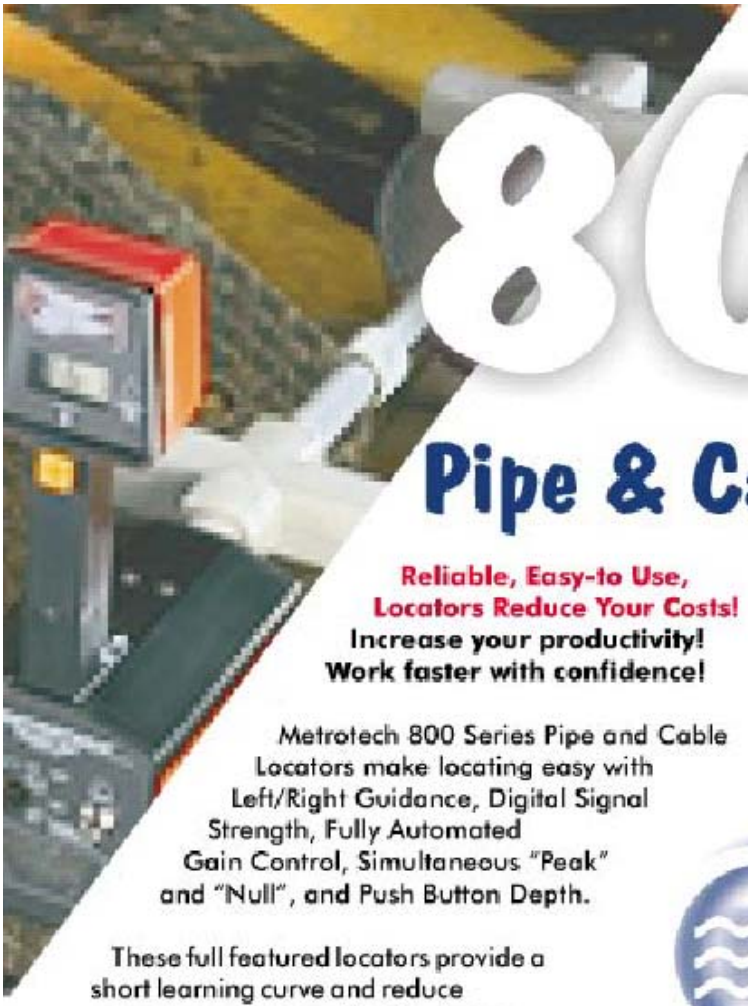
Metrotech - 800 Series



800 Series

Pipe & Cable Locators

Reliable, Easy-to Use,
Locators Reduce Your Costs!
Increase your productivity!
Work faster with confidence!

Metrotech 800 Series Pipe and Cable Locators make locating easy with Left/Right Guidance, Digital Signal Strength, Fully Automated Gain Control, Simultaneous "Peak" and "Null", and Push Button Depth.

These full featured locators provide a short learning curve and reduce operator errors, resulting in a lower cost of ownership.

METROTECH®
See beneath the surface

Saves you time - Simultaneous Peak/Null

Shows You the Path - Left/Right Guidance System and Audible Tone

Pinpoints Your Utility and Indicates Strength of Transmitted Signal - Digital Signal Strength

No Manual Gain Adjustments - Fully Automated

Determines Depth - Quick and Easy Push Button Depth

Lightweight, and All Readouts are Line-Of-Sight, Reducing User Fatigue.

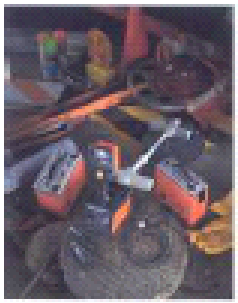
810 High Radio Frequency - 83kHz For Insulated/Gasketed Water and Gas Pipe Applications
- High Frequency Jumps Insulators and Gaskets
- Excellent Inductive Locating, Direct, Clamp
- Use with Sonde

The 810 high radio 83kHz frequency jumps insulators and rubber gaskets often found in water and gas distribution systems. The floodlight quality of high radio signal makes the 810 a superior instrument for inductive locating, and blind or survey locating. The 810 Receiver may also be used with a 83kHz frequency Sonde.

850 Low Audio Frequency - 9.8kHz For Isolation and Long Distance Cable Applications
- Excellent Isolation From Adjacent Utilities
- Efficient High Power 2 Watt Transmitter Facilitates Long Distance Locating
- Transmitter Impedance Matching Maximizes Battery Life

The low audio 9.8kHz of the Metrotech 850 "hugs" the conductor and does not "bleed off" onto adjacent utilities in your locate area. If direct transmitter connection is available, the 850 is an excellent instrument for isolating a utility in a congested area. The powerful 2 Watt Transmitter drives the low frequency signal for long distances. The impedance matching feature of the 850 Transmitter matches the signal to the resistance on the conductor, maximizing power output, and conserving battery life. A 9.8kHz Sonde can be used with the 850 Reciever.

Technical Data



The 810 Pipe and Cable Locator provides versatility for both direct, clamp, and inductive pipe and cable locating.

The powerful 850 Pipe and Cable Locator gives better isolation and longer range tracing of underground pipes and cables in congested areas.

- **Standard Equipment**
  The Metrotech 800 Series consists of a Transmitter, Receiver, Conductor Attachments, Ground Rod, Ground Plate, Carrying Case, and Operation Manual.
- **Accessories**
  Metroclamps 4290 (2"), 4820 (4"-810), 5120 (4"-850), 4890 (8")
  Headphones (P/N 183045),
  Sondes, 810-SONI830, SONH83K,
  850-SONI982, SONH9.8K
  Training Video VHS (P/N 600A073), specify, PAL, NTS
- **Warranty**
  One year warranty on parts and labor.

Transmitter	810	850
Nominal Output Power	250 mW	0.6W and 2W Output
Frequency	83.0775 kHz ± .002% Crystal controlled for interference resistance	9.82 kHz ± .002% Crystal controlled for interference resistance
Batteries	6 NEDA 13F Alkaline D Cells	Rechargeable Lead-Acid 6V
		Charging is by 115V, 60Hz AC power source (by request), or optional 12V vehicle mount charger.
Battery Life	92 hours	92 hours
Impedance Matching		Automatic, no adjustments
Dimensions	8"L x 3.25"W x 7.75"H (20.3 x 8.3 x 19.7 cm)	8"L x 4.125"W x 6.75"H (20.3 x 10.5 x 17.2 cm)
Weight	3.9 lbs (1.8 kg)	5.8 lbs (2.6 kg)

Receiver	810 & 850
Trace Accuracy	+1 inch from 0-3 ft (91 cm) +3% over 3 ft (91 cm) in depth
Depth Readout Accuracy	+(5% + 2") under normal conditions
Depth Readout Range	To 13 ft (400 cm)
Sensitivity Control	Automatic, no adjustments
Batteries	4 NEDA 1604A Alkaline (9V)
Battery Test	Indicated on Meter
Battery Life	150 hours
Temperature Range	0 - 110°F (-18 - 43°C)
Dimensions (Extended Length)	32.5"L x 7.5"W x 12.5"H (82.6 x 19.1 x 31.8 cm)
Weight	4.4 lbs (2.0 kg)

Shipping Specifications

	810	850
Dimensions	24.25"L x 10.375"W x 17.25"H (61.6 x 26.4 x 43.8 cm)	same
Weight	20 lbs (clamp addt'l 2 lbs) 9.1 kg (clamp addt'l .91 kg)	23 lbs (clamp addt'l 2 lbs) 10.4 kg (clamp addt'l .91 kg)

Specifications subject to change without prior notice. Actual performance may be affected by improper signal drive method, concentration of utilities, poor ground conditions such as highly conductive soil, or extremes of temperature. Signal violations on large pipes can also affect accuracy.

This product is covered by US 4387340, RE 41203117, EPO 414 86 and other US and Foreign Patents pending.

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ISO 9001 Certified

METROTECH®
see beneath the surface

Metrotech - RSP3 Plastic Pipe Locator

RSP3

Plastic Pipe Locator

Locating non-metallic piping is no longer a concern with the *NEW* Metrotech ***RSP3*** Plastic Pipe Locator! Using a non-destructive Impulse Generator the RSP3 adds a sound to non-metallic water pipe at hydrants, valves or directly on the pipe. Why worry about damaging your pipes? The RSP3 uses standard water leak detecting methods for tracing and locating PVC and PE pipes. For best results use the Metrotech HL 400 or 4000 water leak detector with the GM 50 piezo microphone. Set-up and operation are simplified with the rugged strap-on Impulse Generator and battery powered controller. Designed with variable impulse and intensity features the RSP3 is perfectly suited for the toughest locating under the most demanding conditions.

Got Plastic?

Got the New Metrotech RSP3 Plastic Pipe Locator!

METROTECH®
See beneath the surface

Features:

The RSP3 is the only plastic pipe locator to use standard water leak detection methods.

Impulse generator removes any worry of damaging pipes.

Fast set-up eliminates water connections or service interruptions.

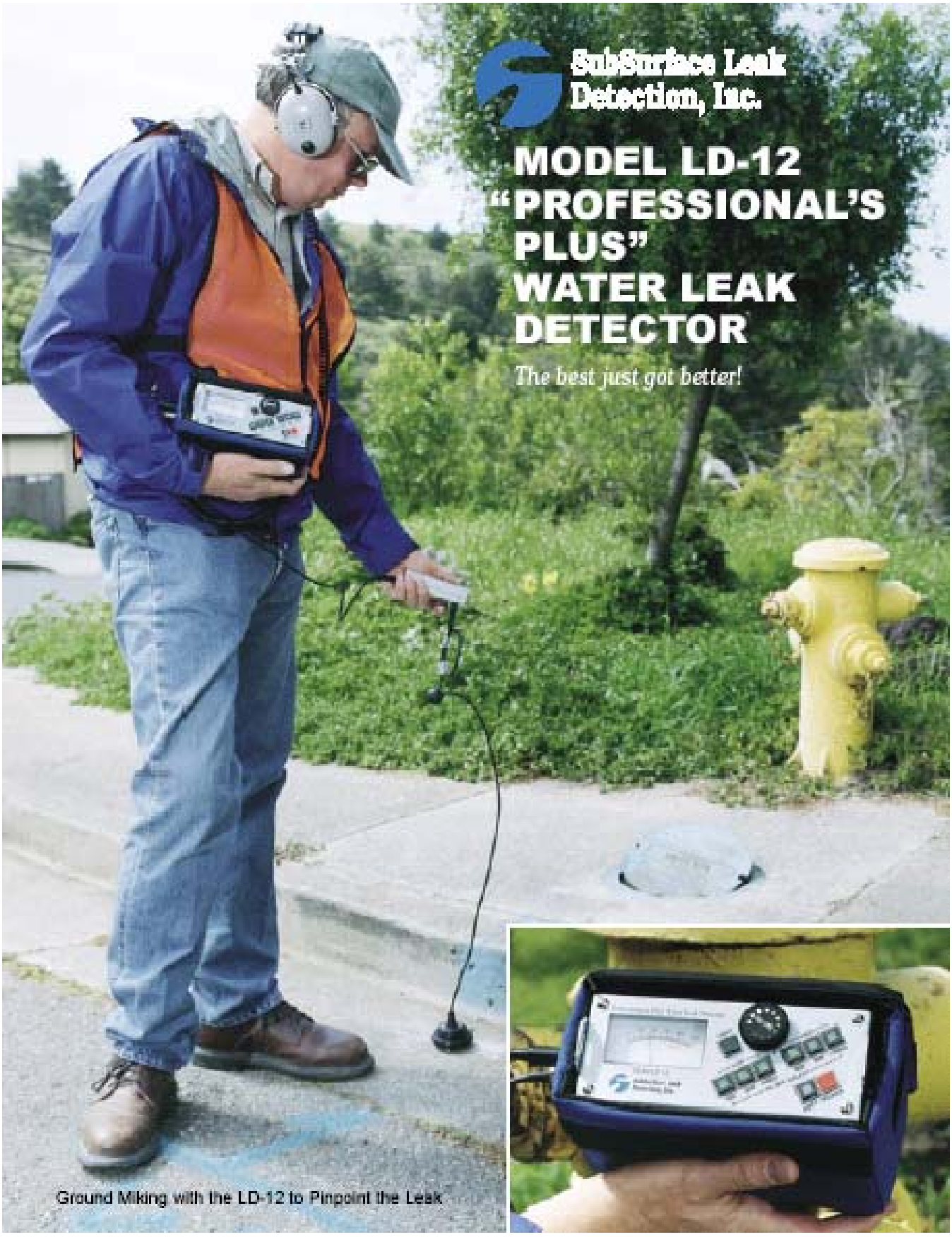
Rechargeable batteries for longer operations and less waste.

Water resistant enclosure for longer life and reliable operations.

Variable impulse and intensity sound generator optimizes use on all type of pipe under all conditions.

SubSurface Leak Detection, Inc

Model LD-12


SubSurface Leak Detection, Inc.
MODEL LD-12 "PROFESSIONAL'S PLUS" WATER LEAK DETECTOR
The best just got better!
Ground Miking with the LD-12 to Pinpoint the Leak

LD-12 "PROFESSIONAL'S PLUS" WATER LEAK DETECTOR

Standard Items

1. Amplifier with Meter Display and Filter Controls
2. Ground Microphone and Handswitch
3. Aviation-Grade Stereo Headphones
4. Heavy-Duty ABS Plastic Carrying Case

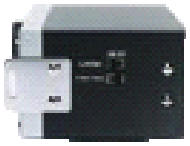
Standard Accessories

5. Magnet Base
6. 3-Section Contact Rod
7. Nut Driver (to remove base)
8. Instruction Manual (not shown)

Features

- Large meter display (with backlight) of sound loudness, allowing the user to pinpoint the exact leak location.
- Light weight amplifier, weighing only 31 ounces, with a padded carrying case and a strap.

- Six selectable filters, split into three "low side" filters (100Hz, 200Hz, or 400Hz) and three "high side" filters (600Hz, 800Hz, or 1200Hz).
- "Limiter" switch which cuts off all loud noises greater than 110dB. If you drop the sensor, you won't hurt your hearing.



- "Filter-Thru" switch, which turns OFF all of the amp's filters, allowing the user to hear all sounds from 50Hz to 15,000Hz.
- High-sensitivity ground microphone and low "electronic noise" amplifier combine to offer the very best quality sound for leak detection.
- Three accessories for attachment to the sensor:
  - Ground plate for pinpointing on streets/slabs
  - Magnet base for surveying at hydrants/valves
  - Contact rod for surveying at meters/fittings

Specifications

Amplifier

• Input Impedance	: 50k ohms
• Output Impedance	: 15 ohms
• Amplification	: 62 dB +/- 3dB
• Frequency Range	: 1) 100Hz to 1200Hz (13 dB) with Filter-Thru OFF 2) 15Hz to 30,000Hz (13 dB) with Filter-Thru ON
• Power	: 6 AA dry cell batteries
• Power Consumption	: 1) 70 mA or less with backlight ON 2) 35 mA or less with backlight OFF
• Battery Life	: 1) 28 hours with backlight OFF (alkaline cells) 2) 14 hours with backlight ON (alkaline cells)
• Weight	: 31 ounces (885 g)
• Size	: 6.7" x 2.8" x 4.1" (170mm x 70mm x 103mm)

ABS Carrying Case

• Weight (full)	: 15 lb. (6.81 Kg)
• Size	: 18.5" x 14.6" x 7.5" (470mm x 371mm x 190mm)

Manufactured by:

SubSurface Leak Detection, Inc.

4040 Moorpark Avenue, Ste. #104
San Jose, CA 95117
(408) 249-4673 (Phone)
(408) 249-9653 (Fax)

Distributed by:

Radiodetection RD500

RD500

The RD500 is an effective solution for locating buried nonmetallic water pipes. It is simple to use and comprises of TransOnde transmitter and a hand held Receiver.

The TransOnde is fitted to a fire hydrant or tap and an internal oscillator reacts to water flow. This applies a distinct pressure wave to the water in the pipe, which is detected by a seismic sensor in the Receiver.

- Visual and audio response
- Meter indicates peak response
- Battery state indicated at switch on
- On/off and sensitivity control
- Headphone socket
- Lightweight

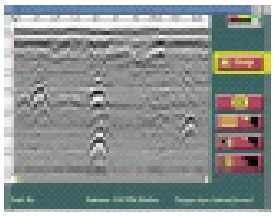
MALA - Easy Locator


New!
MALÅ
EASY LOCATOR
Difficult Locates?
Non-metallic utilities,
unknowns or congested areas?
Easy Locator is the solution where standard locators cannot provide the complete picture. The first user-friendly ground radar designed and priced for the utility locate professional.
LET'S MAKE IT VISIBLE!

EASY LOCATOR

Easy Locator is an easy to use GPR system designed to meet your utility locating demands.

The Easy Locator breaks many barriers in terms of ground penetrating radar systems on the market today. Very little experience is needed to operate the system. With a simple user interface, only a few commands are required to begin scanning at walking speed.



The interface with radargram showing pipes and cables detected.

Easy Locator's GPR technology complements standard electromagnetic techniques in the field providing a cost effective total solution. It can detect both metallic and non-metallic material types including plastics, concrete, ceramics, asphalt composite and more. It provides the user with the exact location of cables, pipes, duct banks, conduits or depth to bedrock.

With its low cost, Easy Locator is an indispensable tool for utility and construction work at urban and industrial sites, minimizing the risks of damage and project delays.

The Easy Locator supports two antennas with different resolution/depth ratio for detecting utilities at various depths. The system can also be adjusted to different soil types for maximum performance and has a backup on-screen cursor function for precise locating of an object. It operates with a unique turn-push controlled and field

rugged monitor with a Ultra-Hi-Brite color screen for maximum visibility in sunlight. Adjustable wheels and an option to operate backwards improve access to rough terrain and loose soils. New functionalities are available through the Internet.

TECHNICAL SPECIFICATION

Power supply:	Li-Ion 11.1V battery
Operating time:	5/10 h with single/double battery pack
Charge time:	5/10 h with single/double battery pack
Operating temp:	-20° to +60°C or 0° to 120 °F
Charging temp:	0° to +45°C or 30° to 110°F
Environmental:	IP65
Monitor:	Ultra-Hi-Brite color 11,4" TFT, Shock tolerant

Antenna	Shallow	Mid
Est. max depth possible:	3.5m/11'	4m/13'
Dim. With wheels (excl. handle)	63x42x19cm / 25"x16"x7"	67x42"x19cm / 26"x16"x7"
Weight, complete	16 kg/35 lb	18 kg/39 lb

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